Fundamentals of Virtual and Augmented Reality
Amitabh Varshney, Computer Science, University of Maryland

Tentative Course Plan

**Lecture 1** History and Overview
ultimate display, early advances, mixed realities

**Lecture 2** Human Perception and VR pipeline
visual, aural, haptic, and vestibular systems
interactivity and interaction

**Lecture 3** Generating virtual worlds
triangle meshes, point clouds, computer-aided design, procedural modeling

**Lecture 4** Cinematic virtual worlds
video-based scene generation
**Assg 1 given**

**Lecture 5** Head tracking
mechanical, ultrasonic, electromagnetic, optical, and inertial measurement units

**Lecture 6** Tracking hands and bodies
marker-based and markerless tracking

**Lecture 7** Head-mounted Displays
principles, challenges, pitfalls, human visual system

**Lecture 8** Stereoscopic Displays
Projection-based displays, autostereoscopic displays, LCD glasses, OLED displays
**Assg 1 due, Assg 2 out**

**Lecture 9** Visual Rendering and Latency
Interactivity, visual persistence, rendering acceleration, foveated rendering

**Lecture 10** Eye tracking and visual saliency
fixations and saccades, FOVE display, pre-attentive vision, psychology of visual salience

**Lecture 11** Introduction to Unity3D – I
architecture and graphics

**Lecture 12** Introduction to Unity3D – II
animation and navigation
**Assg 2 due, Assg 3 out**

**Lecture 13** Aural Rendering
HRTF acquisition, use, and spectral modulation

Class 14: Midterm Exam

**Lecture 15** Haptics Rendering
physics-based simulation, rendering rates, uses

**Lecture 16** Registration
static and dynamic registration principles

**Lecture 17** User Interaction
3D interaction metaphors, one- and two-handed interactions, precision gestures

**Lecture 18** Distributed Virtual Worlds
mirror worlds, shards, and parallel universes
**Assg 3 due, Projects out**

**Lecture 19** Telepresence
principles, challenges, pitfalls

**Lecture 20** Stereo Rendering
textures, billboards, antialiasing challenges

**Lecture 21** Immersion
quantification, psychology, multi-user

**Lecture 22** Case Study: VR in Entertainment

**Lecture 23** Case Study: Augmented Navigation

**Lecture 24** Case Study: Medical Education and Training

**Lecture 25** Case Study: VR in Manufacturing

**Lecture 26** Case Study: VR for Sports Training

**Lecture 27** Wrap-up Review

Class 28: Project Demos and Presentations – I
**Project submissions due**

Class 29: Project Demos and Presentations – II

Class 30: Final Exam